SYLLABUS FOR -CALCULUS UNIT 1-Applied Computer Science and Artificial Intelligence
Prof. BIRINDELLI- 2023- 2024
Definition of real number, proof by contradiction and by induction.
Real functions: (Introduction) Definition, domains, symmetry properties, inverse functions
Properties of powers, logarithms, exponentials and trigonometric functions

Numerical sets:
Intervals open and closed. Bounded and unbounded
Definition of maximum and minimum of a set
Definition of lower and upper bounds of a set

Sequences:
Definition and Properties (monotone, limited)
Sequence defined by recurrence
Definition of Limit for Sequences
Rules on calculating limits (limits of sums, products, quotients, change of variable)
Uniqueness of the limit,
Comparison theorem and the two carabinieri theorem,
Bolzano-Weierstrass theorem (no proof)
Orders of infinities and infinitesimals.

Real functions (Limits and continuity)
Definitions of limits for functions
Continuity and properties on the limits of continuous functions:
Sign theorem (for continuous functions or for limits)
Remarkable limits
Properties of Continuous functions in an interval:
Theorem of existence of zeros and intermediate values (no demonstration)
Definition of local and global maximum and minimum of a function
Definition of sup and inf of a function
Weierstrass theorem (no proof)
Real functions (Derivatives)
Definition of Derivative
Derivatives of sums, products, quotients

Derivative of composite function (chain rule)
Theorem: differentiability implies continuity
Definition of critical point
Fermat's theorem
Lagrange and Rolle theorem
Differential monotonicity criterion theorem (link between growth/decrease and sign of the derivative, using Lagrange's theorem)

Real functions (Higher derivatives)
Concavity/convexity
Taylor formulas with Peano and Lagrange remainders and estimates of the error
How to study the graph of a function
Newton's method

Introduction to complex numbers: Definition, basic properties, nth root of a complex number.